Small Business Innovation Research/Small Business Tech Transfer

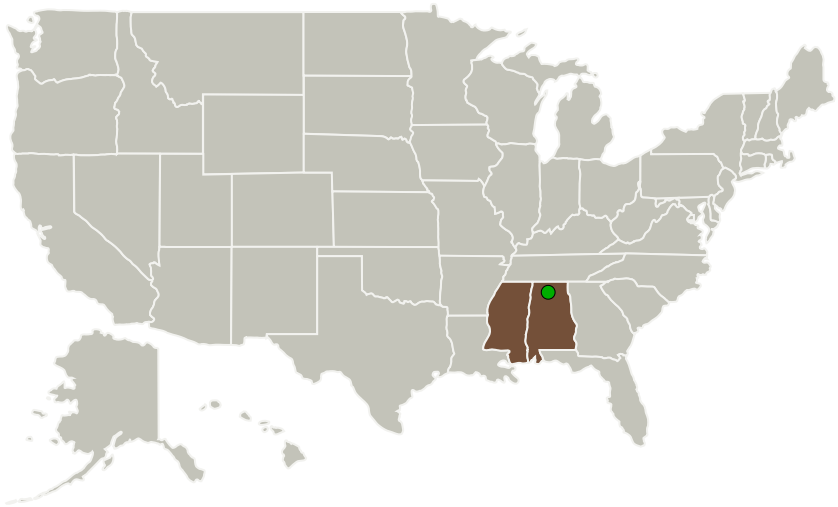
Transient Acoustic Environment Prediction Tool for Launch Vehicles in Motion during Early Lift-Off, Phase I

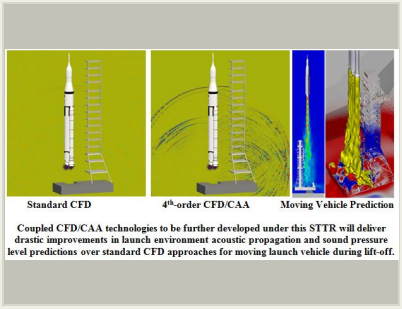
Completed Technology Project (2017 - 2018)

Project Introduction

Launch vehicles experience extreme acoustic loads dominated by rocket exhaust plume interactions with ground structures during lift-off, which can produce damaging vibro-acoustic loads on the vehicle and payloads if not properly understood and mitigated against. Existing capabilities for modeling the turbulent plume physics during early lift-off are too dissipative to accurately resolve the propagation of acoustic waves throughout the launch environment. Higher fidelity non-dissipative analysis tools are critically needed to design mitigation measures (such as water deluge) and launch pad geometry for current and future launch vehicles. This project will build upon existing capabilities to develop and deliver breakthrough technologies to drastically improve predictions of transient acoustic loading for launch vehicles in motion during early lift-off. Innovative hybrid CFD/CAA techniques based on RANS/LES modeling for acoustic generation physics and an unstructured discontinuous Galerkin method will be employed to model long distance acoustic wave propagation along with vehicle motion using ideally-suited high-order accurate schemes. This new paradigm enables: (1) Greatly reduced dissipation and dispersion; (2) Improved modeling of acoustic interactions with complex geometry; and (3) Automatic identification of transient acoustic environment including vehicle motion. Merits of this approach will be investigated and demonstrated during Phase I. In Phase II, the methodology will be refined and validated against realistic targeted applications.

Primary U.S. Work Locations and Key Partners





Transient Acoustic Environment Prediction Tool for Launch Vehicles in Motion during Early Lift-Off, Phase I Briefing Chart Image

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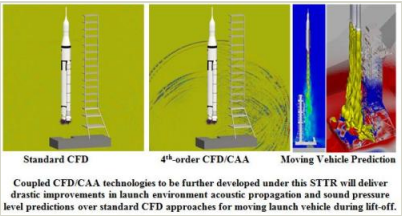
Transient Acoustic Environment Prediction Tool for Launch Vehicles in Motion during Early Lift-Off, Phase I

Completed Technology Project (2017 - 2018)

Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Mississippi

Images



Briefing Chart Image
Transient Acoustic Environment Prediction Tool for Launch Vehicles in Motion during Early Lift-Off, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/127916)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
CFD Research Corporation

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

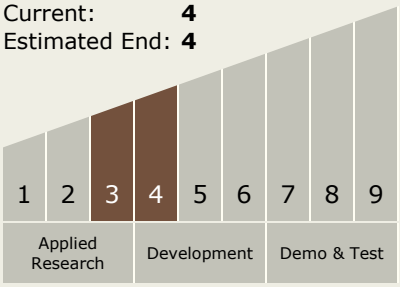
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Robert E Harris

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.4 Solids

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System